

Admissions for Injury at a Rural Hospital in Ghana: Implications for Prevention in the Developing World

ABSTRACT

Objectives. Strategies for injury prevention have been extensively studied in developed nations but not in the developing world. This study sought to determine which mechanisms of injury were common in a rural developing area and which were important contributors to mortality and disability.

Methods. All 614 patients admitted for injuries to a rural African hospital between 1987 and 1991 were analyzed retrospectively for mechanism of injury and outcome, as assessed by mortality and long-term functional status.

Results. The leading mechanisms of injury were transport related (29%) and burns (16%). Burns accounted for 61% of injuries in children under 5 years. Mortality was 7.3% in the series, with 24% of deaths owing to transport injuries. Disability developed in 103 (22%) of the 462 survivors available for assessment, with most disability resulting from transport injuries (26% of all disabilities), burns (13%), and agricultural injuries (14%).

Conclusions. Among injured patients who presented for treatment in this rural developing area, the largest burden of mortality and disability was from burns and transport-related injuries. Population-based studies are needed to substantiate whether these should be priorities for injury prevention efforts. (*Am J Public Health.* 1995;85:927-931)

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Introduction

Injury is well known as a major cause of death and disability in developed nations, where it has been well studied. In developing nations, however, injury has been infrequently studied and its importance is incompletely understood. Although infectious diseases continue to predominate in the overall mortality rates of these nations, injury is often a leading cause of death and disability among older children and adults. Rates of death as a result of injury in these age groups, when adequately studied, are often higher than those in industrialized nations.¹⁻⁸ The number of temporary and permanent disabilities owing to injuries is even greater than the number of premature deaths. The World Bank estimates that 12% of the total "disability adjusted life year" losses worldwide are the result of injuries.⁴ Thus, in view of the greatly limited health care resources in most developing nations, injury prevention emerges as the most likely and most cost-effective approach to reducing the toll from injuries. However, before any prevention strategies can be designed and implemented, the mechanisms of injury that contribute the most to the burden of mortality and disability must be elucidated.

The purpose of this study was to characterize injuries in patients presenting to a rural hospital in Ghana. In particular, we sought to determine what the most common mechanisms of injury were and which mechanisms were most strongly associated with poor outcome in terms of both mortality and functional disability. We thereby hoped to identify potential priorities for preventive measures.

Materials and Methods

In a rural developing area such as the chosen site in Ghana, hospital-based data may incompletely reflect the occurrence of injury in the population as many injured patients might not seek or manage to obtain hospital care. However, because population-based data are currently unavailable, it was felt that hospital-based data would provide the best available estimate of the burden of mortality and disability resulting from the various mechanisms of injury. Accordingly, all injured patients admitted to the Holy Family Hospital in Berekum, Ghana, between January 1, 1987, and December 31, 1991, were evaluated in this study.

The Holy Family Hospital, a 160-bed facility, is the only hospital serving a population of 200 000 in a rural district of 1500 square miles. This district has fewer than 10 miles of paved roads, no telephones or electricity outside of the district capital, and no ambulance service. Most of its population are either self-employed in nonmechanized, subsistence farming or involved in cocoa farming or the timber industry.

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This paper was accepted December 15, 1994.

TABLE 1—Mechanism of Injury (Percentages) by Age Group for Injured Patients Admitted to the Holy Family Hospital, Berekum, Ghana, from 1987 through 1991

Mechanism	0–4 y (n = 98)	5–14 y (n = 124)	15–34 y (n = 236)	35–59 y (n = 126)	≥ 60 y (n = 30)	Total (n = 614)
Transport	11 ^a	23	36	38	27	29
Burn	61	16	5	2	3	16
Fall	6	13	7	18	37	12
Agriculture	4	14	11	10	10	10
Assault	3	0	9	6	0	5
Snakebite	5	16	14	10	10	12
Other	9	18	18	16	13	16

^aPercentage of each mechanism for the given age group in that column. Percentages may not add up to 100 because of rounding.

The Holy Family Hospital is the headquarters for a coordinated church/government network of rural health clinics staffed by nurses and village health workers. These nonphysician practitioners are often the first to treat seriously ill or injured patients, who are subsequently taken to the hospital by either private or public transport. There is no provision for treatment en route to the hospital. The hospital has capabilities for major surgery using ether anesthesia; however, supportive care and diagnostic services are extremely limited. Unfortunately, transfer of acutely ill or injured patients to somewhat better equipped facilities in the capital city is rarely feasible.

Admissions at the Holy Family Hospital are coded in accordance with the *International Classification of Diseases*, 9th revision.⁹ Patients admitted during the study period with any type of injury-related ICD-9 code were selected for review. The handwritten inpatient and subsequent outpatient clinic records of all such patients were analyzed for sex, age, mechanism of injury, time from injury to hospital treatment, prehospital care, injuries sustained, survival, length of hospital stay, and functional outcome. Patients with burns or poisonous snake envenomations were included, but patients with poisonous ingestions were not. The hospital's records, which are kept in English, were abstracted by the authors, who used information from physicians', nurses', and physical therapists' notes.

Mechanisms of injury were grouped (and subgrouped) as transport-related injuries (from a motor vehicle crash or as a pedestrian or bicyclist), burns (from scaldings or fires), falls, agriculture-related injuries (nonassaultive machete wounds and injuries from falling trees),

assaultive (blunt or penetrating) injuries, snakebites, and other (unspecified and miscellaneous). Prehospital care was categorized as to whether the patients were first treated at rural clinics or village health posts. Injuries were graded by the Abbreviated Injury Scale, and Injury Severity Scores were assigned.¹⁰ Body region of principal injury was assessed as that region with the highest Abbreviated Injury Scale score. If two or more regions had equal scores, region of principal injury was assigned in order of priority: head (including face, neck, and cervical spine) ranked above thorax/abdomen, which outranked extremity, which outranked skin.

Long-term disability of survivors was retrospectively assessed from hospital and subsequent outpatient clinic records using a modification of the scale developed by MacKenzie et al.¹¹ Patients with definite disability at the time of discharge were classified accordingly, with modification based on follow-up in the hospital's outpatient department when available. Patients were classified into one of four mutually exclusive categories:

1. Major disability: patients with self-care limitations or injuries that impaired their ability to grasp with the hand or to walk more than one quarter mile.
2. Minor disability: patients with some limitation of function that was not severe enough to be classified as major.
3. No disability: patients who were discharged with no evidence of disability, whether or not they reported for follow-up, and patients who showed no disability at follow-up, irrespective of their status at discharge.
4. No follow-up: patients with potentially disabling injuries who left the hospi-

tal before completing treatment and did not report for follow-up. This group was mostly made up of patients with unhealed fractures.

The mechanisms of injury were evaluated for their association with outcome, as assessed by three variables: mortality, length of hospital stay, and long-term functional status. Patients were grouped in accordance with all etiologic causes, excluding those that were unspecified or miscellaneous. Differences in age, Injury Severity Score, and length of hospital stay among these groups were evaluated using analysis of variance; differences in mortality and disability were evaluated by odds ratios (ORs) and 95% exact confidence intervals (CIs),¹² with comparisons made to the category with the least mortality and least disability (assaultive injuries for both). When numbers of patients were sufficient, statistical analysis of the outcome of the subgroups was also carried out.

Only patients admitted alive to the hospital were used for the above analyses. At the Holy Family Hospital, patients dead on arrival at the emergency department or arriving in terminal condition and expiring prior to being admitted are recorded in the emergency room log. Information on these patients is very limited, and for this study, their deaths were recorded only as a supplement to mortality data.

Results

Demographic Data and Descriptive Epidemiology

During the study period, 614 injured patients were admitted to the hospital. The leading mechanisms were transport and burns (Table 1). Although transport injuries primarily involved motor vehicle crashes (n = 136), 24% of transport injuries involved pedestrians (n = 24) or bicyclists (n = 19). Burns were primarily scalds (n = 47), with lesser numbers due to fires (n = 11) or unspecified mechanisms (n = 39). Agricultural injuries were due to lacerations from machetes (n = 43) and injuries from falling trees (n = 19). There were very few blunt (n = 22) or penetrating (n = 9) assaults; all penetrating assaults involved knives. Other nonassaultive injuries included 51 blunt and 47 penetrating mechanisms. Of the latter, 17 were firearm injuries, none of which were reported to be assaults.

Patients in this series had a mean age of 23.6 ± 17.9 (SD) years. The mean age

of patients injured in falls (33.1 ± 23.9 years) was significantly higher and that of burn victims (8.6 ± 11.5 years) was significantly lower than that for all other mechanisms ($P < .001$). Burns accounted for 61% of all injuries in children under 5 years of age (Table 1); for those in which the mechanism was known ($n = 41$), 85% were due to scaldings, primarily from cooking pots on open, ground-level, wood-cooking fires.

Transport was the leading mechanism for injury among older children (ages 5 to 14), young adults (ages 15 to 34), and older adults (ages 35 to 59), and falls were the leading mechanism among those aged 60 years and older (Table 1). The male to female ratio was 384:230 (63% male), with no difference in mean ages. Males predominated in all mechanisms except pedestrian injuries (42% male), although nearly equal numbers of males and females were injured by burns and snakebites. Altogether, injuries accounted for 3% of nonobstetrical/neonatal admissions during the study period. The leading causes of admissions were pediatric infectious and nutritional disorders.

Patterns of Injury

As Abbreviated Injury Scale and Injury Severity Score categorizations have not been well worked out for snakebites, this mechanism was not included in the analysis of Injury Severity Scores or patterns of injury. Among the 539 patients with mechanisms other than snakebite, the mean Injury Severity Score was 6.7 ± 6.5 , and this score did not vary significantly among the major mechanisms. Twenty-eight percent of patients had a maximum Abbreviated Injury Scale Score of 3, and 8% had a maximum score of 4 or higher. Among the subgroups, more severe injuries tended to occur in pedestrians (mean Injury Severity Score = 9.8 ± 6.7) and people hurt by falling trees (mean Injury Severity Score = 9.4 ± 7.6).

Among the nonburn, nonsnakebite patients, the most common region of principal injury were the extremities (47%), followed by a lesser number of head (23%), torso (13%), and skin (17%) injuries. Head injuries were the leading region of principal injury among bicyclists (42%) and people hurt by falling trees (53%).

Prehospital Care

Information on time to treatment was available on 451 (73%) patients, only 39% of whom presented to the hospital within 24 hours of injury, whereas 47%

TABLE 2—Mechanism vs Mortality and Length of Hospital Stay (LOS) for Injured Patients Admitted to the Holy Family Hospital, Berekum, Ghana, from 1987 through 1991

Mechanism	No. Patients (n = 614)	Mortality (n = 45)		OR	95% CI	Mean LOS, ^a Days (SD)
		No.	%			
Transport	179	11	6	2.0	0.3, 87.3	17.2 (27.9)
Burn	97	6	6	2.0	0.22, 94.0	19.4 (18.2)
Fall	72	9	13	4.3	0.5, 194.0	12.3 (10.1)
Agriculture	62	4	6	2.1	0.2, 105.2	14.3 (14.8)
Assault	31	1	3	1.0	...	15.6 (6.8)
Snakebite	75	10	13	4.6	0.6, 206.9	9.2 (11.6)
Other	98	4	4			17.1 (18.9)

Note. OR = odds ratio in comparison with assaults; CI = 95% exact confidence intervals.

^aThe mean LOS for burns is longer than that for other mechanisms, and the mean LOS for snakebites is shorter than for other mechanisms ($P < .01$).

presented between 1 and 7 days after injury and 14% presented more than 1 week after injury. Only 23% of patients received any type of prehospital care, primarily first-aid measures at village health posts. No patients received ongoing medical care en route to the hospital.

Mortality

Overall hospital mortality was 7.3%, with no significant differences between major mechanisms (Table 2). There were trends toward higher mortality rates for falls and snakebites. Among subgroups, there were trends toward higher mortality rates for injuries from falling trees (21%) and for pedestrian (13%) and bicyclist (16%) injuries. Also of note was the very low death rate from assaults (3%). The largest single contributor to number of injury deaths was transport.

Mortality gradually rose with age. It was 5% for 0- to 4-year-olds, 6% for 5- to 14-year-olds, 8% for 15- to 34-year-olds, 9% for 35- to 59-year-olds, and 13% for those aged 60 and older. Mortality was 5% for females and 9% for males (OR = 1.9; 95% CI = 0.92, 4.2). The greatest number of male deaths ($n = 14$) was in the 15- to 34-year-old group, with the largest single number ($n = 6$) owing to transport. The greatest number of female deaths ($n = 4$) was in the 35- to 59-year-old group, all of which were owing to different mechanisms.

Review of the emergency room records revealed an additional 42 injury-related deaths by patients who either were dead on arrival or expired shortly after. These included 24 motor vehicle injuries, 3 burns, 1 fall, and 14 unknown or unrecorded mechanisms. As data were very limited for these patients and denomi-

nator data for specific mechanisms were not available for emergency room visits, these deaths were not included in the above analyses of mechanism of injury and outcome. Considering hospital and emergency room deaths together, injuries accounted for 4% of all hospital and emergency room deaths and 9% of all deaths in the 10- to 30-year-old age group.

Length of Hospital Stay

For all patients in the series, mean length of hospital stay was 15.3 ± 19.6 days and median length of stay was 10 days. Among the major mechanism groupings, burns and transport-related injuries had especially long mean lengths of stay and snakebites had especially short lengths of stay ($P < .01$) (Table 2). Among the subgroups, pedestrian injuries stood out as having the longest mean length of hospital stay (36.4 ± 63.9 days).

Disability

One hundred seven survivors were excluded from analysis for disability because they left the hospital prematurely with potentially disabling injuries and lacked subsequent follow-up. Altogether, 81% of survivors ($n = 462$) were available for assessment, of whom 103 (22%) manifested some degree of potentially permanent, functional disability at the time of discharge. Follow-up in the hospital's outpatient clinic was obtained on 56 of these patients at a mean of 6.9 months (range = 1 to 41 months) after discharge. Examining physicians in the outpatient clinic found major disability in 13 patients and minor disability in 42 patients. An additional 24 patients with major disability and 23 patients with minor disability

TABLE 3—Mechanism vs Disability for Injured Patients Admitted to the Holy Family Hospital, Berekum, Ghana, from 1987 through 1991

Mechanism	No. Patients ^a (n = 462)	Major Disability (n = 36)		Minor Disability (n = 67)		Any Disability (n = 103)		OR	95% CI
		No.	%	No.	%	No.	%		
Transport	126	6	5	21	17	27	21	2.0	0.5, 11.2
Burn	89	7	8	6	7	13	15	1.3	0.3, 7.5
Fall	49	5	10	6	12	11	22	2.1	0.5, 13.0
Agriculture	39	5	13	9	23	14	36	4.1	0.94, 24.7
Assault	25	0		3	12	3	12	1.0	
Snakebite	61	3	5	6	10	9	15	1.3	0.3, 7.9
Other	73	10	14	16	22	26	36		

Note. OR = odds ratio for any disability (major and minor) in comparison with assaults; CI = 95% exact confidence intervals.

^aSurvivors with adequate follow-up to assess functional status.

showed evidence of disability at discharge but lacked follow-up. Limited functional recovery would be expected in most of the major disability cases owing to the nature of the disability: six patients with contractures, five with amputations, five with loss of muscle and tendon tissue, and two with paralysis. There were no differences in age, sex, or mechanisms of injury for those with or without follow-up. Hence, major and potentially permanent disability developed in 8% of survivors and minor disability developed in 14% of survivors in whom outcome was known.

Assaultive mechanisms resulted in an especially low rate of disability while agriculture-related injuries had an especially high rate (Table 3). Among the subgroups, especially high rates of disability were noted for pedestrian injuries (compared with assaults, OR = 5.3; 95% CI = 0.98, 36.0) and nonassaultive machete wounds (OR = 6.0; 95% CI = 1.3, 36.8). Burns resulted in the largest number of patients with major disability whereas transport injuries resulted in the largest number of patients with any type of disability.

Major disability was slightly more common in those aged 5 to 34 (9%) than in the older groups (5%) primarily because there was more disability from agricultural injuries among the former. Both sexes had equal rates of major disability. However, in males, the largest single contributor was agricultural injuries among the 15- to 34-year-olds (5 of 23 male major disabilities), whereas in females, disability was primarily owing to burns (6 of 13 female major disabilities), which were spread out evenly in the age groups from 0 to 34 years.

Discussion

Infectious diseases continue to predominate as a cause of mortality in most developing nations. However, rates of death from injury are often higher in these nations than in industrialized nations and in most cases are increasing.^{1,2,4,7,8} Furthermore, for every death, several other people are left with temporary or permanent disability.^{1-4,6,7,13} As in industrialized nations, injury-related death and disability primarily affect those in their prime working years, with considerable loss of economic potential to the victims' families and their nations.⁸

Many developing nations can afford to spend only \$2 to \$3 per capita per year for health,¹⁴ compared with \$2500 spent by the United States.¹⁵ In light of such limited finances, prevention emerges as the most likely and most cost-effective method for dealing with the problem of injuries.^{6,8} To address what prevention strategies are needed, however, the predominant mechanisms of injury need to be identified.

Before any inferences can be drawn from our data, three limitations of the study warrant discussion. First, the study is hospital based in an area where the majority of the population probably do not receive formal medical care. The lack of prehospital care and the low percentage of people presenting less than 24 hours after injury indicate that there were probably many out-of-hospital deaths from injuries. We cannot be certain whether the mechanisms of injury of those who survive to reach the hospital are representative of the mechanisms occurring throughout the population. For example,

the proportion of transport-related injuries may be disproportionately high because those injured on major transport routes may have had a higher likelihood of being brought to the hospital. Likewise, the proportion of penetrating wounds of the chest and abdomen may be disproportionately low because victims of such injuries would have been more likely to die in the field.¹⁶ Clearly, calculation of population-based incidence rates for injury and its complications cannot be performed using hospital-based data in this setting. Thus, population-based studies are needed to evaluate the impact of injury and to confirm whether the mechanisms of injury contributing the most to mortality and morbidity are indeed the same as those determined from hospital-based data.

Second, the retrospective nature of data gathering may lead to some misclassification of mechanisms. Some of the pedestrian and bicycle injuries may have been recorded merely as motor vehicle crashes, thus leading to an under representation of these two subgroups. Agriculture-related injury may also be prone to misclassification. While the machete is the single most commonly used tool in non-mechanized agriculture and food processing, some of the machete wounds most likely arose from other activities. Likewise, while exposure to falling trees occurs primarily during timber cutting or clearing of land for farming, exact activities at the time of such injury were not determined. Hence, some of the injuries categorized as agriculturally related may not have been. However, some of the falls occurred during harvesting of tree-grown crops, while many snakebites in rural developing areas occur during the clearing of land for farming.¹⁷

Third, the application of this study's findings to other developing areas is of unknown validity. Urban areas may have higher incidences of transport-related injuries. Similarly, areas with political instability or ongoing ethnic tension may have more pronounced problems with assaultive injuries.¹⁸

Despite these limitations, some conclusions and recommendations regarding injury prevention measures and directions for future research can be drawn from this study. Transport was the leading mechanism for injury-related admissions, the leading cause of injury deaths, the leading contributor to disability, and a leading user of health care resources as indicated

by length of hospital stay. If the toll from this mechanism is indeed borne out by population-based studies, transport-related injuries should be a primary focus for prevention work, even in rural areas with limited distances of paved roads. The number and severity of pedestrian injuries indicate a need for tighter traffic control in more heavily populated areas and for separation of pedestrian areas from automobile routes.^{8,19-24} The predominance of head injuries among bicyclists indicates that helmets present a potential solution. Research needs to be directed toward developing helmets cool enough for tropical climates and inexpensive enough to be affordable by the average person in the developing world.²⁵

Although not a leading contributor to mortality, burns were the leading cause of childhood injuries, accounted for the highest mean length of hospital stay, and were the largest contributor to the number of major disabilities. In light of their frequency and the young age of the victims, scaldings would be a prime target for educational efforts. Such efforts could be grafted onto ongoing well-child clinics and immunization campaigns at little additional cost.²⁶⁻²⁸ Further research is needed to elucidate risk factors for such scaldings,²⁹ and to investigate the effectiveness of passive mechanisms such as barriers around cooking fires, raised hearths,⁸ and locally manufactured wood ovens and stoves.

This study shows agricultural injuries to be a significant cause of disability. Very little has been written about occupational injuries among those engaged in non-mechanized farming, but disabling injuries to the extremities appear to be a frequent occurrence.^{8,30} This is an area into which research is especially needed, as those who are injured are supporting their families. Poisonous snakebites were a major contributor to injury-related mortality in this series. Much has been written about treatment of these injuries, but little research has been done on prevention in the rural developing world.^{8,17}

Lastly, secondary prevention of death and disability once injuries have occurred may be accomplished by improved trauma care. The long delays in presentation to

the hospital and the lack of prehospital care indicate these to be two potential areas for secondary prevention. The use of village health workers and rural clinic nurses has been shown to improve care of many diseases, both chronic and acute, in rural locations in the developing world.^{8,14} Thus, although improved prehospital transport is limited by undeveloped infrastructure in such settings, prehospital treatment could be improved by increasing access to basic primary health care. □

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